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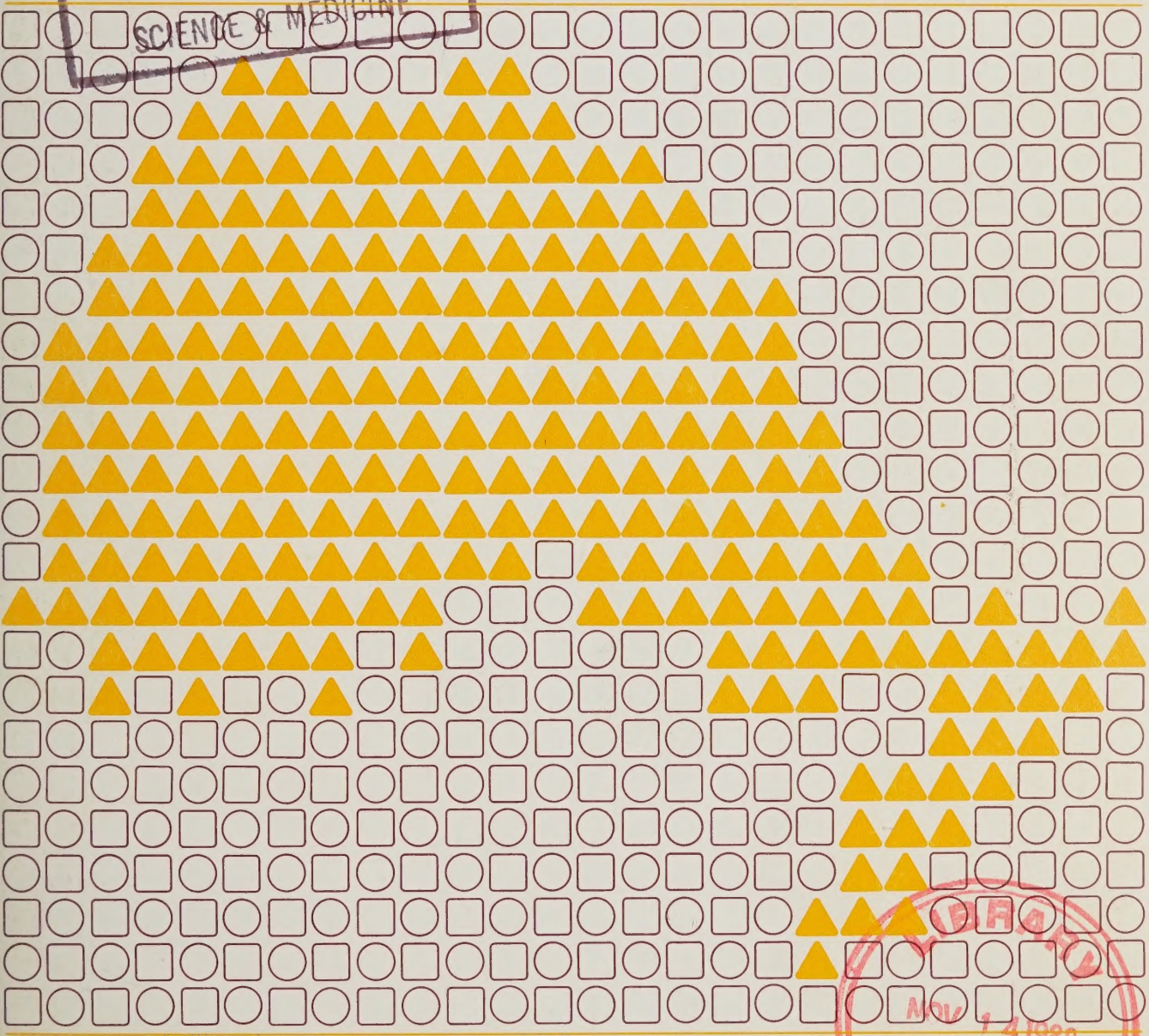
Volume 9, Number 4, Fall 1988

Accidental Ingestion of Soluble Nickel Salts: A Case Report

Optical Protection Factors of Selected Safety Lenses

Development of Designated Substance Regulations by the Ontario Ministry of Labour



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Occupational Health in Ontario

Volume 9, Number 4, Fall 1988

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3. U.S. Department of Health, Education and Welfare. Smoking and Health. A report of the U.S. Surgeon General, 1979.

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J. Blair, M.D., FRCP(C)

Accidental Ingestion of Soluble Nickel Salts: A Case Report

Summary

Following temporary disruption of the water supply in an electroplating plant in June 1987, soluble nickel salts from electroplating tanks contaminated the water to a drinking fountain. Some workers who consumed contaminated water experienced acute gastrointestinal effects, and 11 workers were admitted to a hospital for observation. The potential health effects of ingestion of soluble nickel salts are reviewed.

Key Words: nickel salts, poisoning

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During construction of new washrooms at a large electroplating company, the main fresh water supply line in the plant was damaged by a falling concrete block. This resulted in a slow leak, which was repaired during the normal plant slow-down on a weekend. In order to make the repair, the fresh water supply line in the plant was turned off.

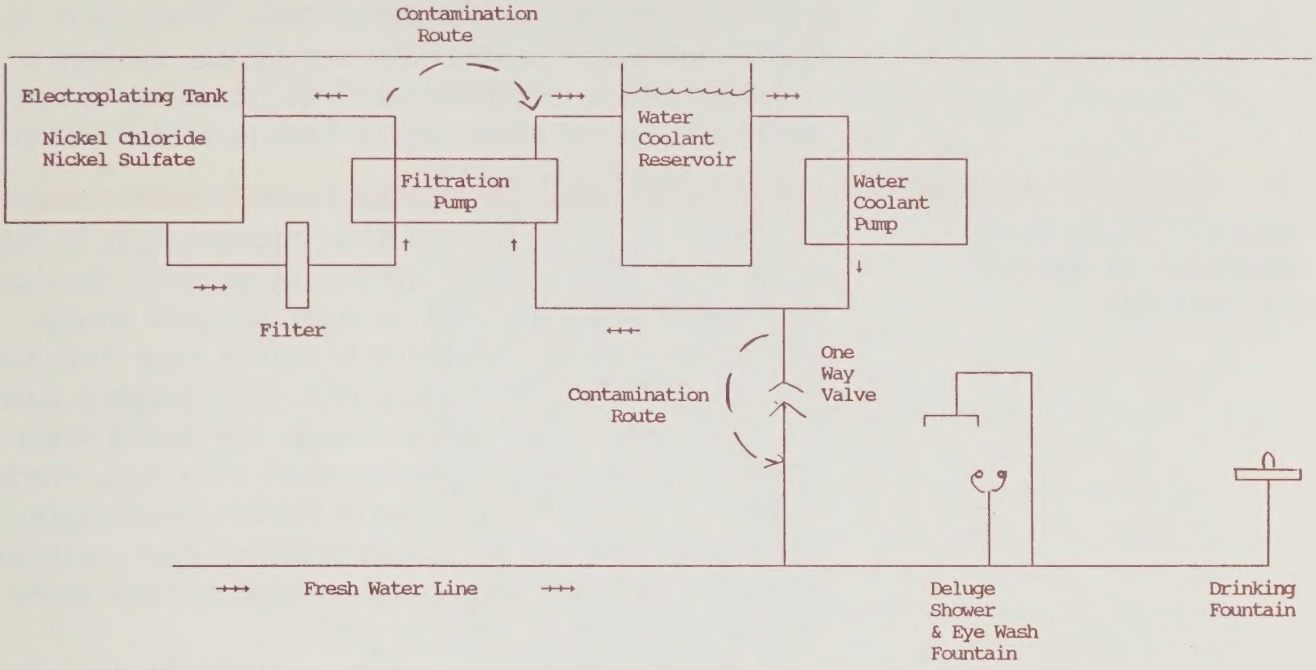
On one electroplating line, the solution in a tank containing nickel chloride and nickel sulphate is continuously filtered, and the filtration pump is water-cooled by a separate recirculating pump. A fresh water line in the plant was inappropriately connected through a one-way valve to the water cooling line for the recirculating pump (Figure 1). Electroplating chemicals can contaminate the recirculating water coolant at the filtration pump. When the main fresh water line for the plant was turned off, contaminated water in the cooling line, under pressure, backed up into the fresh water line. This fresh water line supplied water to an eyewash fountain, a deluge shower and a drinking fountain.

During an evening shift some workers developed nausea, abdominal cramps, diarrhea, headache, palpitations, tingling and dizziness. The workers who developed symptoms were all employed in the vicinity of the drinking fountain, and the symptoms were quickly attributed to the drinking water. Water from the drinking fountain was tested by the company, using its own atomic absorption unit. Nickel was found in the water in a concentration of 2,400 parts per million. The water supply to the fountain was immediately turned off.

It was realized that contamination of the water occurred following repairs to the main fresh water supply line earlier in the day. Water from all drinking fountains in the plant was tested, but nickel was found only in water from the one fountain.

Twenty-nine workers had consumed contaminated water from the one drinking fountain before it was turned off. Within 24 to 48 hours blood and urine testing for nickel was done on all 29 workers. Nickel was detected in the blood and urine of 25 workers. Eleven workers

Figure 1 Electroplating Solution and Water Coolant Circuits.



who had relatively high blood and urine levels of nickel were admitted to the hospital for observation and further monitoring.

The highest initial urinary nickel level was 37,000 μg/L (upper limit of normal in unexposed population, 5 μg/L), and the highest serum nickel level was greater than or equal to 210 μg/L (upper limit of normal in unexposed population, 1.1 μg/L).

Workers admitted to hospital were given extra fluids, both orally and intravenously. No toxic effects with respect to the blood, heart, kidney, liver or central nervous system were noted, and all 11 workers were discharged from the hospital after three days.

The company installed a new water supply line to the fountain with the contaminated drinking water. The plumbing throughout the plant was altered to prevent future contamination of drinking water by electroplating chemicals.

Cooling Systems for Filtration Pumps

Some filtration pumps for electroplating solutions are air-cooled. Larger pumps may be cooled by pumps that recirculate water through a water reservoir. The volume of water in the reservoir tank can be maintained by a water level control valve, but there should be an 'air gap' between the water supply line and the water

in the reservoir. The air gap prevents possible contamination of the water supply line by any electroplating chemicals in the water reservoir tank. When there is a direct connection to the water supply line through a one-way valve, the valve may leak, resulting in contamination of the water supply line, as in this instance.

Health Effects From Ingestion of Soluble Nickel Salts

A median value of 160 μg Ni is ingested daily in food in the U.S. Only a small fraction of nickel in the diet is absorbed in the gut, and the daily systemic absorption in the general population is only 0.5 μg from food sources. Canadian municipal public water supplies have a median nickel value below 2 μg/L, but higher water levels occur near large open-pit mines (200 μg/L average values).[1,2] However, no adverse health effects among community residents have been linked to open-pit mining operations or to the higher than average ambient levels of nickel present in water or air.[3]

In the late nineteenth century, nickel salts were used as oral therapeutic agents for rheumatism and epilepsy. Daily doses of soluble nickel salts, such as nickel sulphate and nickel bromide, of up to 500 mg daily were well tolerated by patients.[3] For an averge 70-kg man, this would be approximately 7 mg/kg body weight. The rat oral LD_{50} for nickel sulphate ($NiSO_4.6H_20$) is 300 mg/kg (moderately toxic-very toxic range).

Accidental oral ingestion of soluble nickel is rare. There are a few poorly-documented case reports involving mixed exposures where gastroenteritis, colic, anaemia and weakness were described as major signs and symptoms. Neurological effects such as tremor, chorea and convulsions have also been described. No biological monitoring was carried out in these case reports.[4]

In the only human case of fatal nickel intoxication that has been reported, a $2^1/_2$-year old girl ingested about 15 g of nickel sulphate crystals. On admission to the hospital, the girl was somnolent with meningeal irritation, wide and unresponsive pupils, high pulse rate, and had pulmonary rhonchi on auscultation. Cardiac arrest occurred after four hours, and the child died eight hours after the poisoning despite repeated resuscitation. Autopsy findings gave no clue to the rapid progression of the intoxication, but increased nickel levels were found in all tissues examined, including liver, stomach and spinal cord, and acute haemorrhagic gastritis was observed.[5]

In animal studies oral administration of nickel causes

gastroenteritis, salivation, respiratory disturbance and cardiac arrhythmia, as well as muscular atrophy, hypoglycemia, anaemia and oedema of the lungs, liver, kidneys, brain and meninges. Increased permeability of blood vessels, kidney tubular dysfunction and cytotoxicity in the central nervous system were also observed in relation to increased doses of nickel.[4]

The nephrotoxicity documented in animals given acute high doses of nickel is associated with proteinuria, aminoaciduria, reduction in urea clearance and histological changes. Electrolytic nickel refinery workers with a urinary nickel excretion above 100 μg/L had an excess level of beta-2-microglobulin in urine. This was interpreted as indicating an effect on the kidney proximal tubules in these chronically exposed workers.[1] Nausea, weakness, headache and palpitations have been reported in a group of 23 dialysis patients when the dialysate became contaminated with nickel. Symptoms occurred during and after dialysis at average plasma nickel concentrations of 3,000 μg/L.[6] The lungs, the heart, the brain and the kidneys may be particularly sensitive to nickel toxicity. The animal and human data taken together suggest that a massive overdose of soluble nickel may cause coronary vasospasm and neurological symptoms such as headache and tremors progressing to convulsions and coma.

Discussion and Conclusion

Because of the similarity of the workers' symptoms with reported cases of nickel poisoning, and the marked elevations in urinary and serum nickel, the exposed workers were carefully hydrated and monitored.

No analysis could be carried out to investigate the relationship between the quantity of water consumed and the urine and blood nickel levels. From experimental data using human volunteers, it may be concluded that these workers must have ingested considerably more than 1 mg of nickel. If the 2,400 ppm measured by the company during the night is taken as a typical or average concentration of the contaminated water, this is equivalent to 2.4 g Ni/L of water. If the workers drank as much as one litre of water they could have ingested up to 2.4 g of nickel. For a 70-kg man this is equivalent to 34 mg/kg nickel.

There are anecdotal reports of humans ingesting up to 7 mg/kg of nickel salts (salt total weight) without any apparent acute adverse health effects, but fatalities could have resulted from this incident since the intake was close to the range of the rat oral LD_{50} of 300 mg/kg,

and the one fatal case reported where the dose was 15 g of nickel sulphate.

After a follow-up period of one year, all the exposed workers have remained well, and there are no signs or symptoms of nickel intoxication. It is still too early to rule out chronic health effects such as sensitization or cancer, so this cohort of workers has been registered with the Workers' Compensation Board.

Résumé

À la suite d'un perturbation de l'approvisionnement en eau d'une usine de galvanoplastie en juin 1987, une fontaine d'eau potable a été contaminée par des sels de nickel hydrosolubles provenant de réservoirs de galvanoplastie. Certains des travailleurs qui ont bu l'eau contaminée ont souffert de douleurs gastro-intestinales aiguës et 11 d'entre eux ont été placés en observation à l'hôpital. One passe en revue les effets qui l'ingestion de sels de nickel hydrosolubles pourraient avoir sur la santé.

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Optical Protection Factors of Selected Safety Lenses

Summary

Spectral transmittance curves for 10 plano safety lenses are presented over the waveband 200 to 2,500 nm. Protection factors for ultraviolet C (UVC), UVB, UVA, blue light and near infrared (IR) radiation were derived from the data. The levels of protection from UVA, blue light and near IR radiation showed considerable variations. The relevance of these variations as they relate to the ocular hazards of ultraviolet and short wavelength visible radiation are discussed.

Keywords: eye protection, safety lenses, optical protection factors, ocular hazards

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Introduction

Many employees in industry are regularly subjected to potentially harmful optical radiation from a wide variety of sources, including laboratory equipment, welding arcs and torches, electric arc furnaces and carbon arcs. Even workers in the vicinity of, but not directly involved with, the operation of such equipment risk personal injury through casual contact. Consequently, there is a need to assess the level of protection from optical radiation provided by currently available industrial eye protectors. Ideally, industrial eyewear should not only protect the wearer from overexposure to hazardous levels of UV and IR radiation, but also reduce the amount of visible light impinging upon the eyes to a level that maximizes comfort and visibility while minimizing photochemical changes and retinal injury. In addition, safety glasses should be comfortable, durable, and capable of withstanding spatter and mechanical abuse without irritating or injuring the wearer.

In this study we assessed the protection from UV, visible blue and near IR radiation provided by safety spectacles and evaluated each relative to manufacturers' claims and the performance of other lenses.

Material and Methods

Ten samples of commercially available plano safety glasses and UV-protective lenses were obtained from various manufacturers for the purpose of assessing the ultraviolet and visible light protection provided by such lenses. A listing of the lenses tested, along with a brief description of the lenses and manufacturers' claims, can be found in Table 1. A reference figure number is also listed to aid in the matching of lenses to respective spectral transmittance curves.

The samples were thoroughly cleaned, and spectral transmittance curves for each were obtained using the Zeiss DMR-21 dual beam recording spectrophotometer in its direct transmittance mode. The DMR-21 has been modified for computer-controlled data acquisition, storage and processing, using software developed at

Table 1 **Lenses Tested**

Lens	Manufacturer	Figure	Description	Manufacturer's Claim
Noviol	American Optical (AO)	1	yellow glass 3.6 mm	UV protection only – does not meet radiant energy requirements of ANSI Z87.1-1968.
UVC-503	Blak-Ray	1	clear polycarbonate 1.9 mm	for protection at 254 nm not exceeding 1200 $\mu W/cm^2$ for a period of 8 hours; meets Z87.1-1968 for UV only, not IR
UV-Absorbing	Fisher Scientific	1	pale yellow polycarbonate 2.2 mm	no more than 2% transmittance in 210 to 405 nm range
Norton 180	Norton Company	3	grey polycarbonate 2.4 mm	no protection from radiant energy claimed
Eyeguard Eagle Green	Safeco	2	green polycarbonate 2.4 mm	flash and impact protector; meets CSA Z94.3-M1982
Eyeguard Eagle Grey	Safeco	2	light grey polycarbonate 2.2 mm	flash and impact protector; meets CSA Z94.3-M1982
Eyeguard 1500 Green	Safeco	2	green polycarbonate 2.5 mm	meets CSA Z94.3-M1982
Eyeguard 1500 Grey	Safeco	2	light grey polycarbonate 2.5 mm	meets CSA Z94.3-M1982
Ultra Spec 2000	Uvex	3	clear polycarbonate 2.5 mm	not for use as IR protector
Pro Spec	Uvex	3	clear polycarbonate 3.3 mm	not for use as IR protector

the School of Optometry, University of Waterloo. The claimed accuracy of transmittance measurements is 0.3 per cent across the waveband 200 to 2,500 nm, used in the study.

Results

Figures 1 to 3 display the spectral transmittance curves of the safety lenses tested. All of the lenses block

Figure 1 Spectral Transmittance Curves of Non-prescription Safety Eyewear*

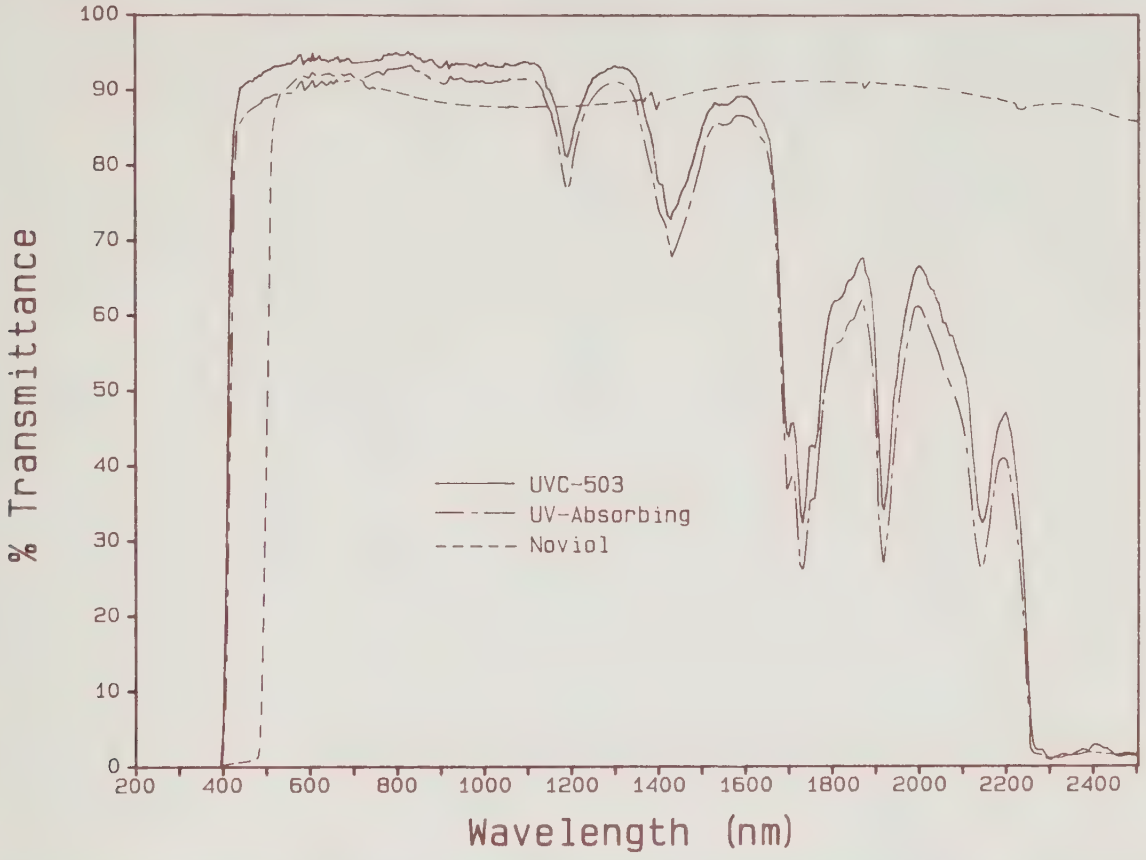
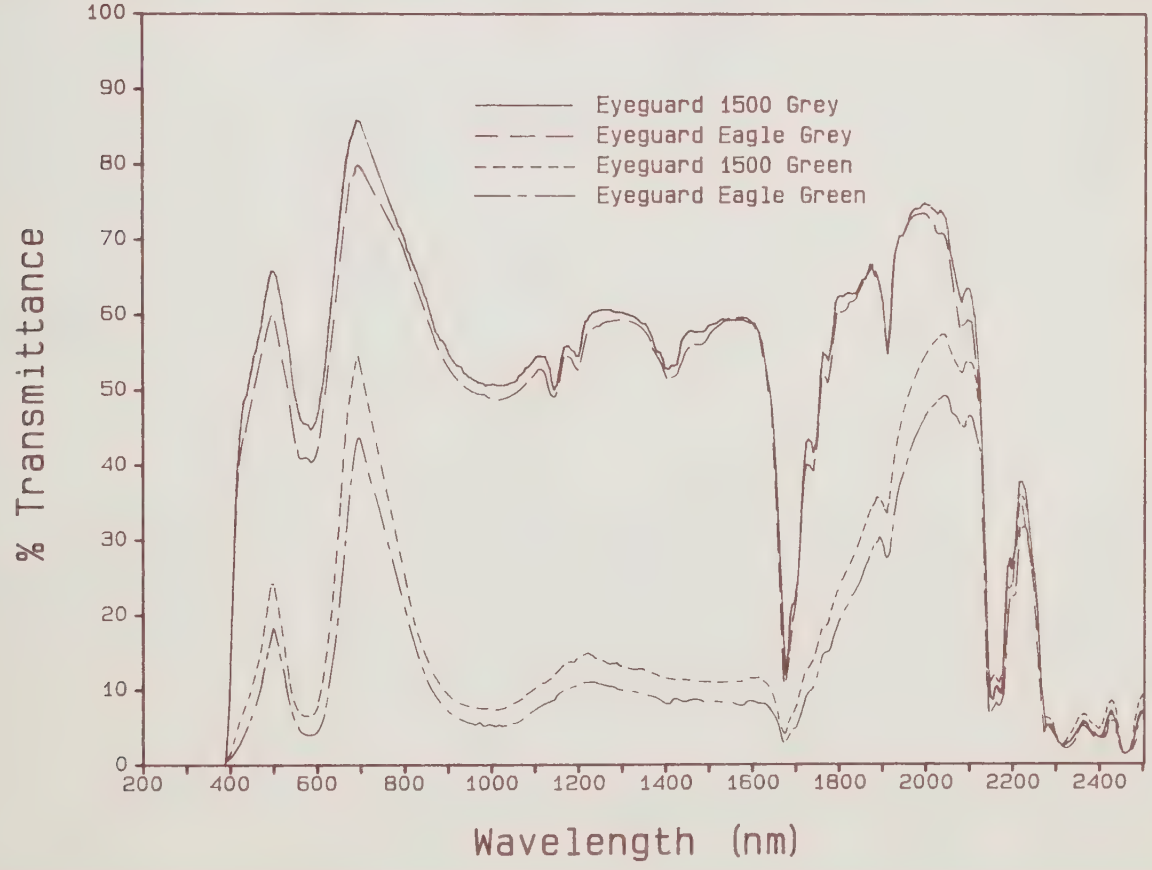
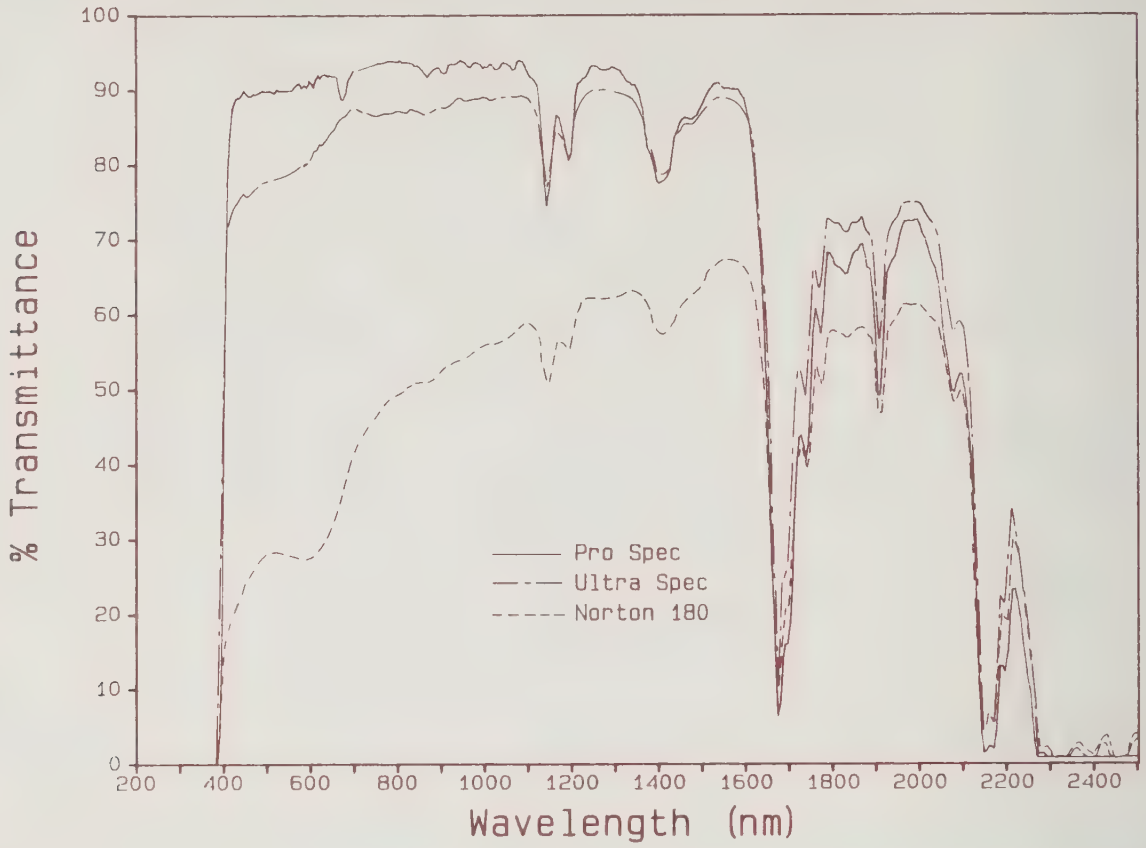


Figure 2 Spectral Transmittance Curves of Non-prescription Safety Eyewear*



*See Table 1 for description of lenses.

Figure 3 Spectral Transmission Curves of Non-prescription Safety Eyewear*



ultraviolet radiation, with cutoffs varying between approximately 360 to 460 nm. In the UV portion of the spectrum, all of the lenses offered similar short wavelength protection with maximum attenuation of both the UVC (200 to 290 nm) and UVB (290 to 320 nm) wavebands. In the UVA range (320 to 400 nm), however, varying degrees of ultraviolet absorption were found. (See Table 2.) Visible light transmission also varied greatly between the lenses assessed, ranging from 10.5 to 89.4 per cent transmittance over the entire visible spectrum (400 to 750 nm) and from 0.1 to 99.4 per cent transmittance over the blue light hazard waveband (400 to 550 nm).[1] The IR transmission showed a similar wide range, from 14.6 per cent to 89.9 per cent. (See Table 2.) Protection factor (PF) values for the lenses in the UVC, UVB, UVA, blue light hazard zone and near infrared range were calculated. (See Table 3.) PF is defined as

$$PF = 1/T\%$$

where T% is the per cent transmittance integrated over a particular waveband.

*See Table 1 for description of lenses.

Table 2 Transmission of Protective Lenses in Selected Wavebands

Lens	UVC (200-290)	UVB (290-320)	UVA (320-400)	Blue 400-550	Visible (400-750)	Infrared (750-2500)
Noviol	<0.1	0.1	0.1	34.8	65.8	89.9
UVC-503	<0.1	0.2	0.5	87.2	89.4	63.3
UV Absorbing	<0.1	0.1	0.3	83.3	87.0	60.0
Norton 180	<0.1	0.1	3.0	24.7	22.8	45.5
Eyeguard Eagle Green	<0.1	0.1	0.2	8.7	10.5	14.6
Eyeguard Eagle Grey	<0.1	0.2	1.4	48.8	44.3	47.7
Eyeguard 1500 Green	<0.1	0.2	0.3	12.7	14.7	18.6
Eyeguard 1500 Grey	<0.1	0.2	1.9	54.0	19.6	49.1
Ultra Spec 2000	<0.1	0.1	7.7	77.8	80.8	61.7
Pro Spec	<0.1	0.1	3.8	90.4	75.2	63.7

Table 3 Lens Protection Factors

Lens	UVC (200-290)	UVB (290-320)	UVA (320-400)	Blue Hazard (400-550)	Infrared (750-2500)
Noviol	>1000	1000	1000	2.87	1.11
UVC-503	>1000	500	200	1.15	1.58
UV-Absorbing	>1000	1000	333.3	1.20	1.67
Norton 180	>1000	1000	333.3	4.05	2.20
Eyeguard Eagle Green	>1000	1000	500.0	11.49	6.85
Eyeguard Eagle Grey	>1000	500	71.4	2.05	2.10
Eyeguard 1500 Green	>1000	500	333.3	7.87	5.38
Eyeguard 1500 Grey	>1000	500	52.6	1.85	2.04
Ultra Spec 2000	>1000	1000	13.0	1.29	1.62
Pro Spec	>1000	1000	26.3	1.11	1.57

In Table 4 we have listed transmittance values at 10 nm intervals over the waveband 290 to 550 nm for all lens types examined. These data can be used to calculate the UV and blue-light protection factors of these lenses for specific sources for which emission spectra are known. The total energy transmitted by a lens in a given waveband can be compared with the TLV for that waveband; a lens that transmits more energy than the TLV would be judged as unsuitable for use with that particular source.

Table 4 Percentage Spectral Transmittance of Lenses Tested

λ(nm)	Noviol	UVC-503	UV Absorbing	Norton 180	Eagle Green	Eagle Grey	1500 Green	1500 Grey	Ultra Spec	Pro Spec
290	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
310	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
320	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
330	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.1	0.1	0.2	0.0	0.1	0.0	0.0
360	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0
370	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0
380	0.0	0.1	0.0	0.0	0.1	0.2	0.1	0.2	6.4	0.0
390	0.0	0.2	0.1	11.5	0.1	3.4	0.1	4.3	40.0	12.2
400	0.0	5.9	5.9	16.3	0.1	16.3	0.1	19.5	66.9	58.1
410	0.0	58.5	58.5	18.7	1.2	31.5	2.1	35.9	71.4	82.1
420	0.0	81.2	77.2	19.6	2.3	40.3	4.5	44.4	73.3	87.1
430	0.0	86.8	83.0	20.4	3.6	43.4	6.1	47.7	74.0	88.0
440	0.0	89.3	86.0	22.0	4.3	45.9	7.4	53.7	75.1	88.7
450	0.0	89.8	86.3	23.5	5.7	48.6	9.4	53.7	75.1	88.5
460	0.1	90.3	86.6	24.3	7.5	51.7	11.9	55.6	75.2	88.2
470	0.2	90.5	87.3	25.7	9.6	54.5	14.5	59.1	76.2	88.5
480	3.2	91.0	87.5	26.2	12.9	56.5	18.1	62.1	76.7	88.7
490	28.6	91.3	88.3	26.8	17.0	58.9	22.4	64.7	76.7	89.0
500	70.6	91.5	88.5	27.2	17.2	58.4	23.2	64.5	77.0	89.0
510	84.8	92.0	88.5	27.3	14.8	55.5	20.1	61.7	77.3	88.8
520	87.3	92.1	88.8	27.2	11.5	52.4	16.5	58.3	77.4	89.0
530	88.9	92.2	89.0	27.0	8.7	49.4	12.4	54.5	77.7	88.9
540	89.3	92.3	89.1	27.0	6.1	45.0	9.4	49.8	77.8	88.9
550	89.7	92.5	89.0	26.5	4.3	41.7	6.9	46.9	77.9	89.1

*See Table 1 for description of lenses.

Discussion

The susceptibility of the human eye to damage from UV radiation has been recognized for some time. This potential for damage has been shown to depend upon the duration of exposure, the intensity of the source, the viewing distance of the observer, the spectral distribution of the radiation and the susceptibility of the individual.[2] Because the human cornea and crystalline lens absorb strongly in the actinic UV range (200-315 nm) and the near UV range (320-400 nm) respectively, these structures of the eye are particularly vulnerable to ultraviolet damage.

Unlike the skin, the eye does not develop a tolerance to UV radiation over the course of repeated exposure. Rather, the eye increases in sensitivity since short wavelength radiation tends to have a cumulative effect – additive if repetition occurs in less than 24 hours.[3-5]

Following suprathreshold exposure to UV radiation, there is usually a latency period of six to 12 hours before there are overt manifestations of the injury. Because radiation below 290 nm damages superficial corneal layers and radiation between 290-315 nm injures deeper corneal structures, typical symptoms of photokeratitis (welder's flash) include intense pain, extreme photophobia, excessive lacrimation and blepharospasm.[3] In addition, autolysis, decreased mitotic rate and loosening of the epithelium have been reported in UV-induced corneal injuries.[6]

The cornea is not the only ocular tissue that may be damaged by UV radiation. Opacities of the crystalline lens have also been produced by UV exposure.[6] Lenticular DNA damage, photo-oxidation of proteins and crosslinking can all be caused by UV radiation, and chronic exposure may lead to the formation of brunescent cataracts.[4] Rapidly occurring irreversible changes in the retinal photoreceptors in the aphakic eye have also been associated with chronic high UVA irradiation.[7]

UV, however, is not the only potentially hazardous optical waveband. Visible radiation, particularly in the waveband 400-550 nm has been shown to damage retinal tissue.[7] Because the retina has a limited ability to repair damage, visible light transmitted to and focused on the retina can result in photochemical destruction and serious retinal injury even with low exposure. This 'blue light hazard' poses a serious threat to the vision of unprotected or inadequately protected workers exposed to radiation in this portion of the spectrum. There is a potential for irreversible injury.[8-10]

We found that certain lenses provided better short wavelength protection than others. While all of the lenses offered similar UVB and UVC protection, major differences were discovered in the UVA and blue light hazard portion of the spectrum, as indicated in Tables 2 and 3.

In the near IR, our PF values show a range between 1.11 and 6.85. There is no correlation between the IR PF values and those in any UV band or the blue light band. While a thermal hazard function analogous to the blue light hazard function exists for retinal exposures,[11] it must be remembered that the near IR is approximately three orders of magnitude less effective in producing photic retinopathy than short wavelength light. The IR threshold irradiance levels for keratopathy and cataractogenesis show even greater differences than the UV thresholds.[12]

The protection factors listed in Table 3 are based on the lens transmission calculated from the integrated transmittance data for each waveband. While these provide a guide to the protective function of each filter, the PF values cannot be used to determine whether occupational exposure to a given wavelength or waveband when the filter is worn exceeds the threshold limit value. Such a determination can only be made when the spectral radiance of the source is known, and when the appropriate blue hazard or thermal hazard weighting function of the radiation, as well as the filter transmittance data, are applied.[1,11] Sliney and Wolbarsht[11] have developed a hazard analysis protocol for this purpose.

Of the lenses tested in this study, only the Blak-Ray UVC-503 and Fisher Scientific UV-Absorbing Spectacle carrry specific claims for UV absorption. The manufacturer claims that the UVC-503 goggle meets the ANSI Standard Z87.1-1968[13] for eye and face protectors, while the Fisher Scientific product is not certified for use when standards or regulations 'require industrial safety specs' (*sic*) or goggles (embossed label on the temples of this Class 1 eye protector). The Eyeguard Eagle and Eyeguard 1500 spectacles appear to differ substantially only in the type of frame used. The grey and green lenses used in these protectors show only slight differences in the transmittance curves, which could be explained as variations between different batches of dyed lenses. The Eagle frame for flash and impact protection is a more snugly fitting 'wrap-around' or 'face-form' type, while the 1500 frame has a straight

front, which affords slightly less protection from radiation sources to the side of the head.

No claim of radiation protection in compliance with ANSI Z87.1-1968. is given for either the Noviol glass lens or the Norton 180 polycarbonate eye protector, although both provide very good UV protection. The Uvex protectors carry a warning on the plastic protective wrapper, advising against use of these products in operations where the eyes may be exposed to 'harmful levels' of infrared radiation. One wrapper cited welding operations as an example. It should be recalled, however, that welding arcs and torches are significant sources of UV and visible light, which cause UV keratitis and photochemical photoretinitis respectively, more readily than thermal photoretinitis.

No shade numbers are specified for any of the lenses tested. Thus the UV, visible and infrared transmission requirements of CSA Standard Z94.3-M1982[14] and the ANSI Standard Z87.1-1968[13] do not apply to these filter lenses. We, therefore, must interpret the claim of compliance with these standards to be solely in the context of **impact resistance.**

In order to achieve maximum protection with minimal visual impairment, industrial environments must be assessed in order to match safety eyewear appropriately to potential optical radiation hazards. (For example, the green Eyeguard Eagle and Eyeguard 1500 lenses would provide adequate protection from both the UV radiation and visible light emitted by a high luminance source such as a printing lamp, whereas a white lens, such as the Blak-Ray UVC-503, would be judged unsuitable. With its high transmission of visible light, the UVC-503 would place the worker at risk of photic retinal damage while providing adequate protection from UV to the cornea.) Although spectral transmittance characteristics are a very important consideration with regard to the selection of industrial ocular protection, other factors, including lens durability and frame design, must be thoroughly investigated in order to avoid ocular and/or facial injuries in those environments where hazards such as chemical splash, flying objects, potential for concussion and contusion exist.[15,16]

Résumé

On présente les courbes de transmission spectrale pour 10 verres de sécurité sans facteur de correction pour la bande de longeur d'ondes qui va de 200 à 2500 nm. À partir de ces données, on a déterminé les facteurs

de protection contre les rayons ultraviolets C (UVC), UVB, UVA, la lumière bleue et le rayonnement infrarouge proche (IR). On a constaté des variations considérables dans les niveaux de protection contre les UVA, la lumière bleue et l'IR proche. On discute de l'importance de ces variations sous l'angle des dangers que représentent pour l'oeil le rayonnement ultraviolet et visible à ondes courtes.

Acknowledgements

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J.R. Wilson

Development of Designated Substance Regulations by the Ontario Ministry of Labour

Summary

The existing process for developing toxic substance regulations is reviewed, and the problems associated with that process are outlined. A new process involving the participation of a bipartite committee of representatives of organized labour and employers is described.

Keywords: regulations, occupational health, exposure standards, labour relations

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The Ministry of Labour has been developing regulations for hazardous substances since the promulgation of the *Occupational Health and Safety Act* (the Act) in 1979. Notices of possible designation (regulation) were issued in 1980, 1982, 1984 and 1985 for a total of 21 substances or groups of substances. To date, 12 regulations have been finalized. From the beginning, the ministry has followed a process of open public consultation to develop these regulations. The following is a summary of how this process has evolved since 1980.

Overview of the Consultative Process

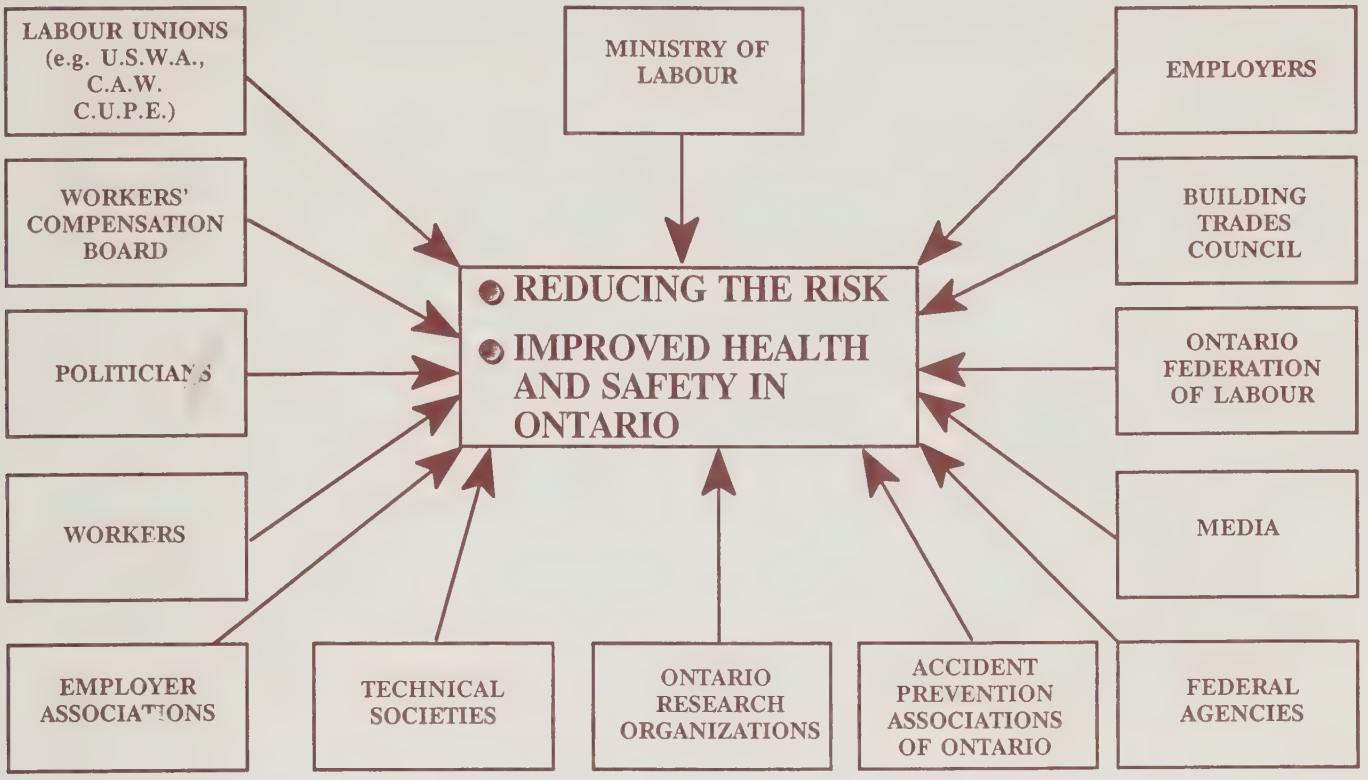
The consultative processes used by the ministry illustrates the extent to which there can be both direct and indirect public input into the development of designated substance regulations. Figure 1 illustrates the large number of interested parties that can be involved in the development of regulations for hazardous substances.

Section 22 of the Act requires that the ministry consult with the public in the development of designated substance regulations:

> **22.** Prior to a substance being designated under paragraph 14 of subsection 41(2), the Minister,
>
> (a) shall publish in *The Ontario Gazette* a notice stating that the substance may be designated and calling for briefs or submissions in relation to the designation; and
>
> (b) shall publish in *The Ontario Gazette* a notice setting forth the proposed regulation relating to the designation of the substance at least sixty days before the regulation is filed with the Registrar of Regulations. 1978, c. 83, s. 22.

The process that has been developed goes far beyond the minimal requirements set out in the legislation. In order to improve it over the years, the ministry added a number of new approaches and steps. An important

Figure 1 **Health and Safety and its Stakeholders**



source of ideas has been the advice received from the minister's Advisory Council on Occupational Health and Occupational Safety.[1]

To the end of 1987 the development of regulations for designated substances involved six distinct phases, each of which included a number of steps. The six phases were:

I. The assembly of background information and preliminary consultations with industry and labour.

II. The publication of a notice of possible designation and the analysis of comments received from interested and affected parties on the intention to designate.

III. Distribution of Ministry of Labour health effects documentation and analysis of comments received. (This step gradually became part of Phase I.)

IV. The publication of a proposed regulation, followed by the analysis of comments received.

V. The holding of an open meeting to present the changes made to the proposed regulation and a review of comments submitted following the meeting.

VI. The review of the proposed regulation by the advisory council and the submission of the regulation to Legislative Counsel and then to cabinet.

While the ministry had originally envisioned developing standards in about nine months, the process has been much slower. Not counting the proposed noise regulation, the average time required to develop each of the first nine regulations was some 27 months. In the past several years the process has been even slower. With the exception of acrylonitrile and benzene, regulations for the second group of eight proposed designated substances will each require more than three years to promulgate.

Both labour and management groups have been critical of the progress made to date. Labour has complained that they do not have adequate resources to be full participants in the process. Industry has objected to the drawn-out process of designation for two basic reasons:

1. The process requires too much time of individuals; and
2. Ministry of Labour priorities do not reflect corporate priorities.

Ministry staff themselves have grown increasingly frustrated with the progress of individual regulations.

There are, however, valid reasons why the ministry's designation process has been slow. Experience has shown that the fundamental issues involved in standard setting in the occupational health field are: dealing with scientific uncertainty; priority setting; and economic cost-benefit analysis. In each case, the ministry has tried to find a common ground between the often conflicting demands of employers and workers.

Standard Setting Processes in the Occupational Health and Safety Field

Standard setting in the occupational health and safety field is an economically, politically and ethically complex process. It is rife with conflicting values, principles and processes. Many of these conflicts cannot be resolved in any final way but can only be balanced or managed within certain limits. Often the ministry finds itself balancing opposing forces; those who tend

toward more government intervention (more standards, tougher enforcement) and those who wish to see market solutions (deregulation, guidelines approach).

Dealing With Scientific Uncertainty

Occupational health has been called an area of 'trans-science'. Trans-science has come to mean those areas of public policy that are based on scientific issues and that can be couched in scientific terms, but for which science has no definitive answers.

Some of the major problems that must be dealt with in standard setting involve scientific and technological issues. In recent years, as concern over toxic substances and carcinogens has grown, controversy has arisen over the validity of animal tests, *in vitro* tests of mutagenicity, the need for proof that a hazard exists, the burden of proof, whether chemicals should be considered safe until proven otherwise or should all chemicals be considered unsafe until proven safe and what level of risk is 'acceptable'?

For many of these questions science offers no clear solution to decision makers. This can result in long delays in finalizing regulations.

Priority Setting

There is no doubt that priority setting is one of the most difficult tasks facing any public administrator in the field of occupational heath and safety.

As noted above, one of the most pervasisve aspects of priority setting, and one difficult for governments to deal with, is controversy over scientific and technical data regarding the nature of the health hazards posed by toxic substances. Another difficulty is the gap between the hazards identified by scientists and those identified by workers and unions at worksites, from workers' compensation claims or by the media. The conflicts that can arise between experts, labour, management, government and the media may lead to a political identification of a hazard rather than a purely scientific one.

Values and emotions are very much a part of the public perception of risk and its acceptability; politicians and regulators must as often respond to a perception of reality as they do to reality itself.

The ministry has not escaped criticism in the priorities it established for designated substances.

Economic Cost Benefit Analysis

Since the mid-1970s there has been, in the United States and, more recently, in Canada, an increasing demand for deregulation. Part and parcel of the move to deregulate has been a clamouring for socio-economic impact assessments of proposed regulatory initiatives.

Cost Benefit Analysis (CBA) may be applied where values can be attached to costs and benefits of particular policies in a meaningful, economic sense. However, in occupational health and safety, this can be done only in exceptional circumstances. In most cases, the process will lead to questionable conclusions and will suffer from a built-in bias to understate benefits and overstate costs. In addition, the costs of introducing CBA on a large scale are sufficiently high to suggest that the expense of hearings and studies may exceed the benefits.

In general, the ministry has relied upon the voluntary submission of comments from affected parties at the publication stage of a Notice of proposed designation or a proposed regulation in *The Ontario Gazette* to draw its attention to the potential economic impact of a proposal. While opposing any regularized and detailed approach to economic impact assessment, the ministry has demonstrated a willingness to examine the potential impact of proposed regulations when affected parties demonstrated that such potential exists. This approach has not always proven to be satisfactory, especially in the eyes of organized labour.

Changes to the Consultative Process

Clearly, much of the delay in developing designated substance regulations has been due to the repetitive technical controversies and questions of scientific evidence that have arisen. This is particularly true of proposed designated substances that are considered to be carcinogenic. If the kinds of scientific tests that should be used as evidence of the existence of various types of health hazards can be established and accepted by all parties, then the regulatory process should be greatly accelerated.

This is an extremely difficult and controversial task. Ministry officials came to realize that unless the aid of both management and labour were enlisted in solving this problem there was little hope of speeding the development of designated substance regulations while retaining the consultation mode of standard setting.

Advisory Committees

The ministry explored a number of ways to improve the consultative process. One way involves the use of advisory committees representing interested and affected parties. Such committees could be struck and disbanded by the ministry as particular hazards are considered. This would allow the inclusion of expertise specific to a given hazard. However, some argued that a better approach would be a permanent advisory committee. There is likely much to be gained from a continuing panel whose members do not have to resolve scientific and technical controversies that recur every time a standard for a toxic substance is being developed.

A permanent committee can also be provided with a research and analysis capability. Given the extent of the politicization of the scientific issues associated with occupational health hazards, it is likely that only research conducted under the aegis of a permanent committee representing all interests will have credibility with both management and labour. In addition, such a research arm would go a long way to solving the problem of labour's lack of scientific and technical resources. The committee could also operate as a funding agency for external research.

In 1982 the advisory council (the council) prepared a discussion paper entitled, 'The Control of Workplace Carcinogens', which was distributed to interested parties.[2] One issue which the council specifically requested comment on was the question of whether an advisory committee(s) should be established with the responsibility of advising the ministry on all aspects of a regulatory program for carcinogens. In particular, comments were requested on whether the advisory committee should recommend appropriate categories and regulatory controls for specific substances. Nineteen respondents representing industry, labour and various associations commented on the issue of such advisory committees. Fifteen of the 19 respondents were in favour of such a committee(s).

Clearly, many of the parties involved in the standard setting process in Ontario approve of the basic concept of advisory committees. Since 1982, both organized labour and other interested parties have met with ministry officials and submitted briefs to advocate the adoption of advisory committees. The Ontario Federation of Labour (OFL) often voiced support for a permanent bipartite committee of full-time members, paid for by

government but without direct government participation; the committee would make decisions, not the ministry. The committee would not be necessarily made up of experts or scientists, but would have technical support and research staff.

The OFL submitted a detailed brief in February 1984 entitled 'Towards a More Comprehensive Approach to Regulation of Workplace Health Hazards'.[3] The brief criticized the existing consultative process and called for a new approach to regulation making, involving a permanent bipartite standard setting committee.

Respondents for other than organized labour, on the other hand, were virtually unanimous in arguing that such committees should be advisory only and be comprised of qualified experts or scientists; the ministry would retain all decision making responsibilities.

In October 1984 the Canadian Chemical Producers' Association (CCPA) submitted a brief entitled 'A Strategy for Occupational Health and Safety in Ontario'[4] also calling for a new approach to regulation making for toxic substances. The CCPA did not advocate the use of bipartite committees and favoured maintaining the traditional decision making power of government.

Thus, two very different types of committee were being advocated.

Both employer groups and organized labour continued to lobby the ministry over the years to change its consultative process. Relations between the ministry and its client groups became increasingly polarized. In November 1986 the ministry published a general chemical hazard regulation, the Regulation respecting Control of Exposure to Biological or Chemical Agents (O. Reg. 654/86). Both employer and labour groups were critical of the perceived lack of consultation by the ministry in the development of the regulation.

The advantage of the consultation process adopted by the ministry was that it allowed affected interests the opportunity to present arguments, though not necessarily face-to-face. The ministry was obliged to listen to those arguments and to respond to them in explaining its decisions. The process left the ministry free to gather its own evidence and to base its decision on considerations not advanced by any party. This approach encouraged the ministry to enter into negotiations with affected parties, thereby expanding the range of options considered and encouraging innovative solutions.

The major shortcomings of the process were the delays in decision making and the inability to resolve conflicts

between competing interests. It did not allow face-to-face negotiations by the parties and it encouraged the adoption of extreme positions. The process was also susceptible to the limitation of or distortions in information provided by the affected parties to the ministry and did little to overcome the basic inequality between labour and management in terms of information and resources. There were also too many repeated invitations to the public to comment in writing to proposals made by the ministry.

The process provided no means of preventing repeated technical controversies, which resulted in delays in decision making. This holds particularly true for carcinogens. The ministry would listen to the arguments for and against a proposal from each side, attempt to second-guess their respective 'bottom lines', and come up with a compromise. In reality, the compromise often did not meet the needs of either party.

The ministry was often seen as an advocate for one side or the other. The labour movement, in particular, argued that the process was not truly open but was, in fact, closed and secretive. They believed that the ministry made decisions based on confidential information supplied by industry. For example, the ministry was accused of carrying out secret cost-benefit studies based on information supplied by employers that was not made available to labour.

In summary, the process did not allow for conflict resolution and consensus building. In failing to achieve this, the ministry was unable to build broad support for its regulatory program.

The question facing the ministry was how to accelerate the pace of regulation while maintaining, and even improving, the quality of consultation. The ministry and representatives of industry and organized labour focused increasing attention on the search for a solution, particularly in the last two years as frustrations with the present process mounted.

The Joint Steering Committee on Hazardous Substances in the Workplace

In April 1987 the OFL requested that the ministry facilitate a meeting with industry representatives to initiate discussions on how to set up a bipartite steering committee for regulation development. In May 1987 the Occupational Health and Safety Division's Legislative Review Committee recommended that the minister

approach representatives of labour and mangagement to ask them to participate on a bipartite advisory committee to provide advice to the minister on amendments to the list of chemicals and exposure values in O. Reg. 654/86.

On July 15, 1987 the minister wrote to senior representatives of both employers and organized labour requesting that they participate in a working group to work on details for a joint committee to develop and review regulations for toxic substances in Ontario workplaces.

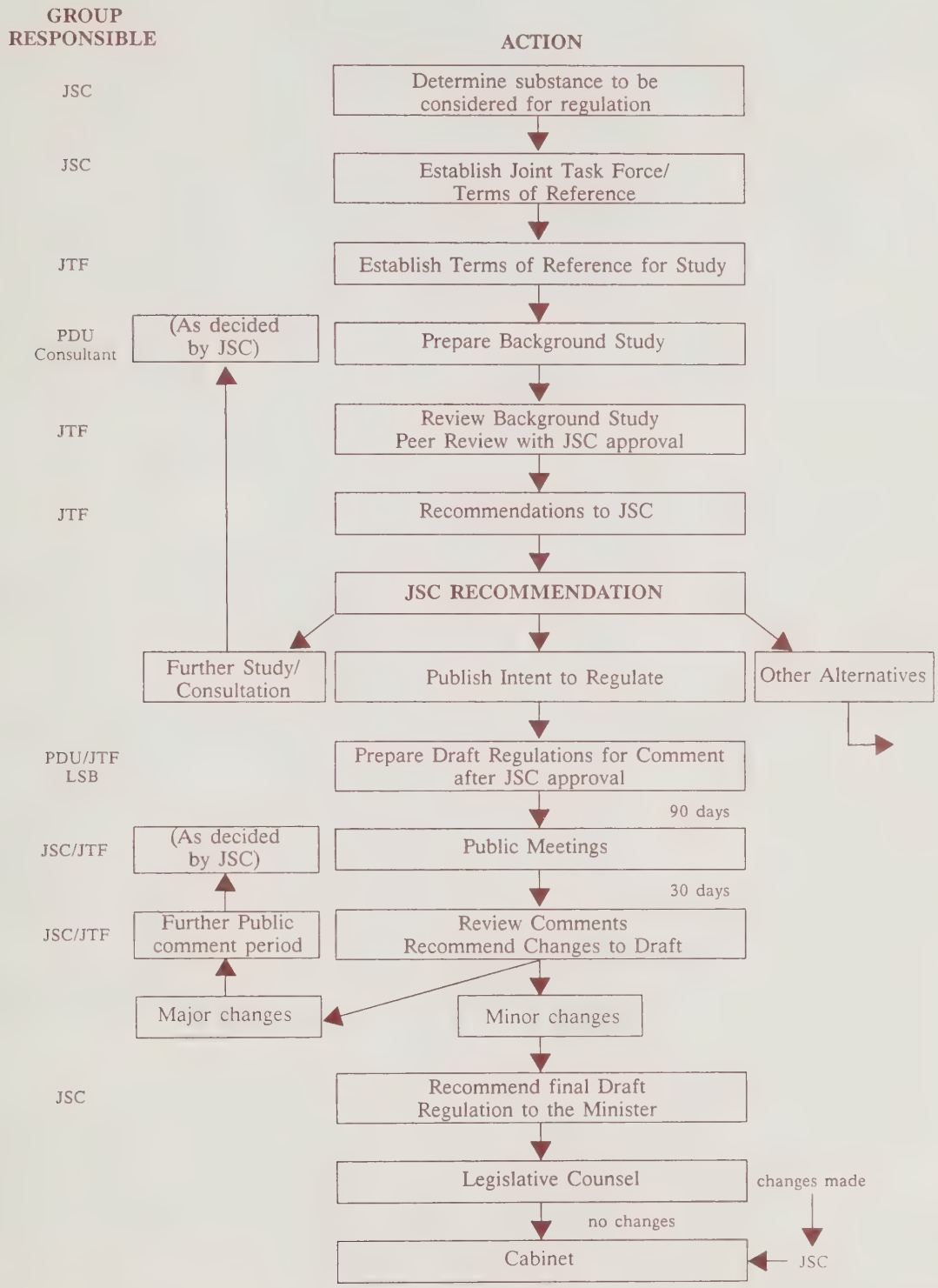
The ministry held an exploratory meeting on September 9, 1987 with representatives of employers and organized labour to discuss the bipartite committee concept. The meeting was highly successful, and the parties arrived at a consensus that the committee be bipartite but be chaired by a senior ministry official. A second meeting of the working group was held on October 13, 1987 to discuss further the membership of a steering committee and its mandate. The members of the working group were asked to nominate representatives to be members of a bipartite committee.

In November 1987 the Minister of Labour appointed an equal number of labour and employer representatives to the Joint Steering Committee on Hazardous Substances in the Workplace in accordance with section 11 of the *Occupational Health and Safety Act*. The primary objective of the joint steering committee is to develop and review regulations and exposure values for hazardous substances, including biological and physical agents, and to make recommendations to the minister. The committee's terms of reference are listed in Appendix 1. The first meeting of the committee was held on December 9, 1987, and regular meetings are held on the fourth Tuesday of each month.

The committee members represent organizations with the greatest interest in toxic substance regulation, and they include a broad representation of employers and organized labour (see Appendix 2). In order to keep the committee to a workable size, direct representation had to be restricted. However, co-ordinating groups have been established to create close working relations with those organizations concerned with the regulation of hazardous substances but not directly represented on the steering committee to ensure that their concerns are incorporated into committee deliberations.

The formation of the committee is not intended to preclude any interested organization from meeting with

Figure 2 Joint Steering Committee on Hazardous Substances Regulation Development Process (Revised)



JSC – Joint Steering Committee
JTF – Joint Task Force
PDU – Program Development Unit
LSB – Legal Services Branch

ministry officials to discuss concerns related to occupational health and safety in Ontario and, in particular, the developent of regulations to protect workers from exposure to hazardous substances.

The committee has approved a revised consultative process for the development of regulations that ensures that the public has full opportunity, through hearings (to be held in the evening or on weekends in various locations in the province) and written submissions, to comment on and participate in the development of proposed control strategies for hazardous substances. The new process is illustrated in Figure 2. It is hoped that this revised process will result in the speedier development of regulations and new or revised exposure limits for O. Reg. 654/86. The development of regulations by an employer/labour consensus process should also result in improved acceptance and faster implementation by the workplace parties.

The committee has appointed three joint task forces designed to achieve consensus on several fundamental issues related to setting standards and developing regulations for hazardous substances. These are:

1. Regulatory Framework and Classification Task Force;
2. Health Surveillance Task force; and
3. Exposure Values and Limits Task Force.

The ministry is providing the task forces with clerical and technical support through its Program Development Unit. It is likely that ministry officials and external consultants hired by the ministry will develop the technical information required to meet the task forces' objectives. It is expected that these initial task forces will submit final recommendations to the committee by the end of 1988.

It is hoped that the committee will be able to develop an annual review process for the exposure limit values in O. Reg. 654/86. In addition, all existing proposed designated substance regulations will be considered by the committee, which will make recommendations to the minister on each.

Résumé

On étudie le processus utilisé actuellement pour élaborer des règlements sur les substances toxiques et on donne un aperçu des problèmes que présente ce processus. On décrit une nouvelle approche faisant appel à la participation d'un comité bipartite composé de représentants des syndicats et des employeurs.

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Appendix 1

Joint Steering Committee on Hazardous Substances in the Workplace

Final Terms of Reference

Primary Objective of the Joint Steering Committee

To develop and review regulations for hazardous substances (including biological and physical agents) made under the *Occupational Health and Safety Act* (the Act).

Secondary Objectives of the Joint Steering Committee

1. To ensure as far as is possible that the regulations for hazardous substances effectively minimize the risks to health and safety in all workplaces in Ontario.

2. To ensure as far as is possible that the regulations and exposure limits developed or approved by the joint steering committee are acceptable to both employers and workers in Ontario.

Terms of Reference of the Joint Steering Committee

1. To review the current regulatory framework and make recommendations on new approaches to the regulation of hazardous substances in Ontario.

2. To advise the minister on priorities for the development of regulations for hazardous substances.

3. To advise the minister on policies, principles and

procedures to be used in standard setting by the government and by the joint steering committee.

4. To review and make recommendations to the minister on the introduction of new substances to the schedule to O. Reg. 654/86.

5. To review and make recommendations on new or revised exposure limits for those substances listed in or added to the schedule to O. Reg. 654/86.

6. To review and make recommendations about designation of substances under the Act.

7. To advise the minister on priorities for research and data gathering relating to the regulation of hazardous substances.

8. To make recommendations on matters referred to it by the minister, submitted to it by interested parties or pursued by the joint steering committee on its own initiative.

9. To prepare an annual report to the minister, which shall include the joint steering committee's advice and recommendations, and the government's response and notice of those issues for which consensus could not be reached.

Appendix 2

Joint Steering Committee on Hazardous Substances in the Workplace

Name of Labour Representative	Name of Association/Union
Ms. Linda Jolley (Labour Chairperson)	Ontario Federation of Labour
Mr. Colin Lambert Ms. Janet Bertinuson (alternate)	Canadian Union of Public Employees
Ms. Noelle Andrews Ms. Cathi Carr (alternate)	Ontario Nurses Association
Ms. Kim Perrotta	United Electrical Workers
Mr. James Phelan Mr. Robert Martin (alternate)	The Canadian Conference of Teamsters (Chemical, Energy and Allied Workers Division)

Mr. John Lang Mr. Rick Briggs (alternate)	Confederation of Canadian Unions
Mr. Joe Duffy	The Provincial Building and Construction Trades Council of Ontario
Mr. Bob DeMatteo	Ontario Public Service Employees Union
Mr. Norm Carriere Mr. Dan Ublansky (alternate)	United Steelworkers of America Energy and Chemical Workers' Union
Mr. Karl Doerwald (Employer Chairperson)	The Canadian Manufacturers Association
Mr. Gary Sparks (alternate)	Canadian Foundry Association Motor Vehicle Manufacturers Association Transportation Safety Association of Ontario Inc. Industrial Accident Prevention Association Transportation Safety Association of Ontario Inc.
Mr. Linc Simpson Mr. Hugh Eisler (alternate)	Canadian Chamber of Commerce (Ontario) Aggregate Producers' Association of Ontario
Mr. Donald Haycock Mr. Richard Sheppard (alternate)	Canadian Federation of Independent Business
Ms. Mary Roy Mr. Richard Murry (alternate)	Canadian Manufacturers of Chemical Specialties Canadian Paint and Coatings Association Adhesive and Sealants Manufacturers' Association Ontario Painting Contractors' Association Rubber Association of Canada

Mr. Peter Budzik Mr. Bruce Caswell (alternate)	Canadian Chemical Producers Association Ontario Petroleum Association Society of the Plastics Industries of Canada
Mr. Bruce Campbell Mr. Bill Sparks (alternate)	Ontario Mining Association Canadian Diamond Drilling Association Forest Products Accident Prevention Association Ontario Forest Industries Association Pulp and Paper Makers Safety Association Canadian Institute of Treated Wood Mines Accident Prevention Association
Ms. Julia McIlraith Ms. Carolyn Shushelski (alternate)	Ontario Hospital Association Association of Municipalities of Ontario Council of Ontario Universities Canadian Society of Hospital Pharmacists Health Care Occupational Health and Safety Association Ontario Association of Medical Laboratories Ontario Medical Association Ontario Pharmacists' Association
Mr. David Frame	Council of Ontario Contractors Associations
Ms. Jan Logan Mr. George Michaud (alternate)	Electrical and Electronic Manufacturers Association of Canada Information Technology Association of Canada

Book Review

Information Resources in Toxicology. Second Edition.

Philip Wexler.

Elsevier, 1988.

The Preface indicates that this is a book 'of "information resources" . . . addressed to anyone who has a need to know where to look for toxicology information. A library cataloger may describe it as an annotated bibliography and directory.' The Ministry of Labour Library has the first (1982) edition in the reference section; library staff estimated that this text is used by library users (all users combined) once per month at most.

The book is divided into two parts: United States Resources and International Resources. Part I begins with a brief historical overview. Chapter 2 ('Bibliography: Books, Special Documents, Journal Articles'), which is over 150 pages long (or more than one-third of the total book), consists entirely of reference books and journal articles, most book entries being accompanied by a brief synopsis of about 50 words. This mammoth chapter is divided into sections such as general works; analytical toxicology; biochemical, cellular, molecular toxicology; carcinogenesis and mutagenesis/genetic toxicology; a section on chemical and materials toxicology, with subsections on pollutants such as anesthetics; arsenic; asbestos; benzene; formaldehyde, and so on; a section on metals with subsections; pesticides; radiation; and a section on target sites (with subsections by organ system). It is of interest that the section on benzene (page 66) contains seven articles but does not contain either the 1987 update of the NIOSH cohort study of rubber workers, in which the association between benzene exposure and leukemia has been quantitatively examined, or the previous analysis published in 1981.

There is a chapter on computerized information sources, which mentions a number of data bases, including the familiar ones such as Chemline, Medline, RTECS and Toxline, used by the Ontario Ministry of Labour Library for searches, as well as many others. Part I is completed by a number of sections focusing on the United States scene, including Legislation and Regulatory Issues; Regulation of Chemicals in the United States; Education/Schools; and Mutagenicity Testing Laboratories in the United States.

Part II (International Resources) is over 100 pages in length and includes chapters on each of about 15 countries, varying in length from three pages (China and Egypt) to 24 pages (Italy). There are seven and eight pages devoted to Canada and Great Britain respectively. These country-specific chapters include information on organizations, poison control centres, professional associations, schools and legislation. The section for Canada includes a listing of sources of extramural support of toxicology research in Canada and a listing of 'Canadian Legislation' (only federal acts are included). There is a brief mention of the Canadian Centre for Occupational Health and Safety under the organizations section, but not enough to explain to the uninitiated the centre's role in data dissemination. One cannot tell from the chapter that occupational health is primarily a provincial matter in Canada.

In summary, this book contains a wealth of information concerning book and article references, and addresses for contacts with organizations. However, the references contained may soon be out-of-date if very current information is sought. It is not likely that the average occupational health professional would have reason to use this volume very often, and would certainly not need his or her own copy. It may be reasonable for a Ministry of Labour or university library to obtain a copy to keep in its reference section.

G.M. Liss

Coming Events

October 5–8, 1988	ICOH Scientific Committee – Second International Workshop on Personal Computer and Data Banks in Occupational Health, PALMA DE MALLORCA, SPAIN. For further information, contact: Dr. Jose Sevillaa, Mutua Balear, c/. Obispo Campins 4, Palma de Mallorca, Balear Islands, Spain.
October 17–20, 1988	Rocky Mountain Occupational and Environmental Health Conference (VIII). PARK CITY, UTAH, U.S.A. For further information, contact: RMCOEH/Continuing Education, Registration Co-ordinator, University of Utah, Bldg. 512, Salt Lake City, Utah, 84112.
October 17–21, 1988	Ontario Occupational Health Nurses Association Conference. HAMILTON, ONTARIO, CANADA. For further information, contact: J. Dalgetty, Medical Department, Stelco Inc., Box 2030, Hamilton, Ontario, Canada, L8N 3T1.
October 24–26, 1988	International Conference on Industrial Health. KITAKYUSHU, JAPAN. For further information, contact: T. Okuba, M.D., Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Yahata Nishi Ku, Kitakyushu 807, Japan.
October 24–28, 1988	International Conference on Ergonomics, Occupational Safety and Health and the Environment, BEIJING, CHINA. For further information, contact: Conference Administrator, ICE-O-SHE, Darling Downs Institute of Advanced Education, P.O. Box 44, Darling Heights, Toowoomba, Qld, Australia, 4350.
October 24–28,1988	Nasal Carcinogenesis in Rodents: Relevance to Human Health Risk. ZEIST, THE NETHERLANDS. For further information, contact: Ms Flora de Vrijer, TNO-CIVO Toxicology and Nutrition Institute, P.O. Box 360, 3700 AJ Zeist, The Netherlands.

October 25–27, 1988	10th Canadian Waste Management Conference. WINNIPEG, MANITOBA, CANADA. For further information, contact: Ms S. Hunt, Seminar Co-ordinator, Technology Development and Technical Services Branch, Conservation and Protection, Environment Canada, Hull, Quebec, Canada, K1A 0H3.
October 31–November 2, 1988	COPE '88: Conference on Protective Equipment. TORONTO, ONTARIO, CANADA. For further information, contact: Mr. J. Quall, 178 Rexdale Blvd., Rexdale, Ontario, Canada, M9W 1R3.
November 8–10, 1988	Canadian Occupational Health Conference, 1988. OTTAWA, ONTARIO, CANADA. For further information, contact: Dr. J. Kirkbride, Health and Welfare Canada, Rue du Chardon, Tunneys Pasture, Ottawa, Ontario, Canada, K1A 0L3.
November 10–11, 1988	International Conference on Air, Water and Environmental Pollution and Hazardous Wastes, BOMBAY, INDIA. For further information, contact: Dr. V.M. Bhatnagar, P.O. Box 1779, Cornwall, Ontario, Canada, K6H 5V7.
November 18–December 2, 1988	International Conference on Occupational Hazards in Agriculture and Industry. CAIRO, EGYPT. For further information, contact: CPHA International Heath Secretariat, 1335 Carling Avenue, Suite 210, Ottawa, Ontario, Canada, K1Z 8N8.
April 11–14, 1989	BOHS Annual Conference, WARWICK, ENGLAND. For further information, contact: BOHS Secretariat, 1 St. Andrew's Place, Regent's Park, London, England, NW1 4LB.
May 18–19, 1989	10th European Conference on Environmental Pollution. CAPRI, ITALY. For further information, contact: Dr. V.M. Bhatnagar, P.O. Box 1779, Cornwall, Ontario, Canada, K6H 5V7.
May 22–26, 1989	Second Meeting of the International Neurotoxicology Association. SITGES, BARCELONA, SPAIN. For further information, contact: Dr. E.R. Farré, Secretariat II INA Meeting, Department of Pharmacology and Toxicology, CSIC, Jorge Girona Salgado, 18-26, E-08034 Barcelona, Spain.

June 8–9, 1989	9th International Symposium on Environmental Pollution. TORONTO, ONTARIO, CANADA. For further information, contact: Dr. V.M. Bhatnagar, P.O. Box 1779, Cornwall, Ontario, Canada, K6H 5V7.
August 28–30, 1989	International Conference on Blood-Borne Infections in the Workplace. STOCKHOLM, SWEDEN. For further information, contact: International Conference on Blood-Borne Infections, CONGREX AB, P.O. Box 5619, Stockholm, Sweden, S-114 86.
August 28–September 1, 1989	CLIMA 2000 – Second World Congress on Heating, Ventilation, Air Conditioning and Refrigeration. SARAJEVO, YUGOSLAVIA. For further information, contact: CLIMA 2000, Masinski Fakultet, Prof. Dr. E. Kulic, 71000 Sarajevo, Omladinsko Staliste 66, Yugoslavia.
October 3–6, 1989	Occupational Medical Assocation of Canada – Annual Meeting. HALIFAX, NOVA SCOTIA, CANADA For further information, contact: Dr. F. Mills, Corporate Medical Director, John Labatt Ltd., P.O. Box 5870, London, Ontario, Canada N6A 5L3.
November 16–17, 1989	International Conference on Air, Water and Environmental Pollution and Hazardous Wastes. NEW DELHI, INDIA. For further information, contact: Dr. V.M. Bhatnagar, P.O. Box 1779, Cornwall, Ontario, Canada, K6H 5V7.
September 22–29, 1990	23rd International Congress on Occupational Health. MONTREAL, QUEBEC, CANADA. For further information, contact: Dr. M. Lesage, Chairman of the Organizing Committee, 84 rue de Brésoles, Montréal, Québec, Canada H2Y 1V5.

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